Central Air Conditioner and Heat Pump Shipments Spreadsheet Documentation

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The Central Air Conditioner and Heat Pump Shipments Spreadsheets are spreadsheet forecast models for future air conditioner and heat pump sales. Each model (one for central air conditioners and one for heat pumps) uses equipment stock accounting together with a consumer decision model and equipment repair and breakdown information to forecast future air conditioner or heat pump shipments under a variety of potential efficiency standards scenarios. Because two sets of manufacturer costs are being analyzed, one based on data submitted by the Air Conditioning & Refrigeration Institute (ARI) and the other based on data developed from a reverse engineering analysis (Rev Eng) conducted by Arthur D. Little, Inc. (ADL), each model allows for one of the two cost options to be selected.

The **Welcome** sheet is the main user interface for shipment forecast calculations. When the user clicks on the **Welcome** worksheet tab, a user interface appears. Different standard levels and scenarios for start year and price option (either ARI or Rev Eng) can be run.

Basic Operating Instructions:

1. Once you have downloaded the shipments spreadsheet file from the Web, open the file using Excel. At the bottom, click on the tab for the **Welcome** worksheet.

2. The screen will display three tables (*Average Impact 2006 to 2030*, *Impact at 2006,* and *Specification of Standard*)and one chart (*Shipments of Central A/C* or *Heat Pumps*). (Use Excel's **View/Zoom** commands to change the size of the display to make it fit your monitor.)

3. To run different scenarios or standards cases, simply choose the desired options in the three list boxes which appear in the upper left of the worksheet. Click on the arrow on the right side of each box to see the options. The first of the three boxes can be used to choose the standard level. The second box can be used to choose the start year of the standard. The third list box is used to choose the price option, i.e., whether to base the shipments forecast on ARI or reverse engineering manufacturer cost data.

4. The spreadsheet is also designed so that the user can change the purchase price, operating cost, and income elasticities of the shipments forecast model. The specific values of the shipments model elasticities are in the **Inputs** worksheet. Those squares that represent elasticities are highlighted in yellow. The user may change these elasticities in order to investigate different model sensitivities.

Using these steps the user can explore the model predictions and how these vary depending on the assumptions and model parameters that are used.

Frequently Asked Questions (FAQ)

How many Shipments spreadsheets are there?

There are currently two Shipments spreadsheets; one for central air conditioners (**ship_cac.xls**) and another for heat pumps (**ship_hp.xls**). Each spreadsheet allows the user to generate shipments of either split or single package systems. The user can also choose between two sets of manufacturer costs; one based on data submitted by the Air Conditioning & Refrigeration Institute (ARI) and the other based on data developed from a reverse engineering analysis (Rev Eng) conducted by Arthur D. Little, Inc. (ADL).

What do the Central Air Conditioner and Heat Pump Shipments Spreadsheets do?

The central air conditioner and heat pump shipments models provide a forecast of the potential sales impacts of different central air conditioner and heat pump standards. The purpose of the models is to provide a 'best guess' of future sales under various scenarios. The spreadsheets also contain estimated populations of each age category of central air conditioners and heat pumps for each year. Furthermore, estimates of several categories of purchases are provided including early replacements and regular replacements.

What are the Worksheets in the Workbook?

In order to simplify the organization and presentation of the spreadsheet calculations, the computations are segregated into separate worksheets. Details for the calculations will be provided in a future Techincal Support Document (TSD). Below we describe in general terms the different functions of the individual spreadsheets.

Welcome

The **Welcome** sheet is the main user page. It provides the list boxes where a user can select a range of shipment forecast scenarios. The user can choose the standard level, the start year, and price option (either ARI or Rev Eng). Tables are presented which summarize the impacts relative to a baseline case calculated with average values for the assumptions. This worksheet is protected to help the user avoid erroneous modifications. The sheet can be unprotected by going to Tools –> Protection –> Unprotect Sheet.

Inputs

The **Inputs** sheet contains the detailed parametric inputs to the shipments forecast model. These inputs include the elasticities and initial market shares for each of the market segments. The non-

highlighted cells in this worksheet are protected to help the user avoid erroneous modifications. The sheet can be unprotected by going to Tools –> Protection –> Unprotect Sheet. Also included on the Inputs sheet is a button in the upper right hand corner of the worksheet called *Calculate Shipments*. Once the user 'clicks' on the *Calculate Shipments* button, the shipments spreadsheet automatically forecasts the shipments for each standard level and saves the results to the **Shipment Summary** worksheet.

Shipment Summary

The **Shipment Summary** worksheet is used in conjunction with the *Calculate Shipments* button on the **Inputs** worksheet. The **Shipment Summary** worksheet stores the shipments forecasts for each standard level after the user 'clicks' on the *Calculate Shipments* button.

Shipment Forecast

The **Shipment Forecast** worksheet provides the detailed estimates and accounting of central air conditioner or heat pump populations. This sheet contains the core of the shipments calculation and the tables which specify the estimates of each type of central air conditioner or heat pump purchase. The tables in the sheet provide accounting of each type of central air conditioner or heat pump ownership category, and each type of central air conditioner or heat pump for each age category of central air conditioner or heat pump. The detailed equations that are used to calculate flow of central air conditioner or heat pump stocks will be presented in a future Technical Support Document (TSD). The total numbers of central air conditioner or heat pump sales of each category are tabulated in summary tables in the cell range AM5 to AT88.

Energy Price

This worksheet provides input data of the forecasted energy prices and income. The prices that are used are average prices as described in the Energy Information Administration's Annual Energy Outlook (see URL http://www.eia.doe.gov/oiaf/aeo99/homepage.html).

MS New Homes

Here we provide the market share calculation for the new housing market based on the logit probability of purchase model. A logit probability of purchase model estimates how purchase probabilities change as a function of price, operating cost savings, and income changes. Details of the model will be explained in a future Technical Support Document (TSD).

MS Early Replace

Here we provide the market share calculation for the early replacement market based on the logit probability of purchase model, and an initial probability of purchase that is a linear function of central air conditioner or heat pump age.

MS non-owner

This sheet provides the market share calculation for the non-owners who purchase central air conditioners and heat pumps and become new equipment owners.

MS Replace

This worksheet calculates the probability of replacement vs. repair as a function of economic decision parameters for each year. The annual probability of replacement is calculated for each age category of central air conditioner or heat pump.

Retirement Function

The worksheet shows the fraction of central air conditioners or heat pumps that are expected to retire as a function of years since the central air conditioner or heat pump was purchased new. (Repairs may extend the life of the equipment and are accounted for in the worksheet **Shipment Forecast**.)

How does the user operate the spreadsheet?

The user operates the spreadsheet by going to the **Welcome** worksheet and choosing the parameters for the scenarios of interest. These parameters include one of several standard levels, the start date of the standard, and the price option (based on either ARI or Rev Eng manufacturing cost data). The results will be displayed in the chart on the **Welcome** worksheet and in the tables which detail changes in sales, shipments, equipment age, repair rate, and replacement rate for the early replacement market.

What kind of output does the spreadsheet generate?

The spreadsheet provides output in both charts, summary statistics, and tables. General output -- including a plot of the shipments forecast and tables summarizing potential standards impacts -- are presented in the **Welcome** worksheet. Meanwhile the detailed tables of the different types of shipments and the populations of different types of stocks for different equipment age categories for each year are presented in the **Shipment Forecast** worksheet.

How does a user change the model elasticities?

The user can change the individual model elasticities by going to the **Inputs** worksheet and changing the different model elasticities highlighted in yellow. Note, that if one makes changes in elasticities on the **Input** sheet, this likely will affect the historical base case.